DOCUMENT RESUME

ED 479 465 IR 022 141

AUTHOR	Graesser, Arthur C.; Hu, Xiangen; Person, Natalie; Jackson, Tanner; Toth, Joe
TITLE	Modules and Information Retrieval Facilities of the Human Use Regulatory Affairs Advisor (HURAA).
PUB DATE	2002-10-00
NOTE	9p.; In: E-Learn 2002 World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education. Proceedings (7th, Montreal, Quebec, Canada, October 15-19, 2002); see IR 022 093.
AVAILABLE FROM	Association for the Advancement of Computing in Education (AACE), P.O. Box 3728, Norfolk, VA 23514. Tel: 757-623-7588; e-mail: info@aace.org; Web site: http://www.aace.org/DL/.
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS
DESCRIPTORS	Computer Assisted Instruction; *Computer System Design; *Ethics; Information Retrieval; Intelligent Tutoring Systems; Laboratory Experiments; Multimedia Materials; *Natural Language Processing; *Research Tools; Training
IDENTIFIERS	*Research Ethics

ABSTRACT

The Human Use Regulatory Affairs Advisor (HURAA) is a Web-based facility that provides help and training on the ethical use of human subjects in research, based on documents and regulations in United States Federal agencies. HURAA has a number of standard features of conventional Web facilities and computer-based training, such as hypertext, multimedia, help modules, glossaries, archives, links to other sites, and page-turning didactic instruction. HURAA also has more intelligent features: an animated conversational agent that serves as a navigational guide for the Web facility; lessons with case-based and explanation-based reasoning; document retrieval through natural language queries; and a context-sensitive Frequently Asked Questions, called "Point & Query." This paper describes the major modules and features of HURAA and evaluates the performance of document retrieval through natural language questions. (Contains 21 references.) (Author)

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Modules and Information Retrieval Facilities of the Human Use Regulatory Affairs Advisor (HURAA)

Arthur C. Graesser
Department of Psychology
University of Memphis
Memphis, TN 38152-3230
a-graesser@memphis.edu

Xiangen Hu
Department of Psychology
University of Memphis
Memphis, TN 38152-3230
xhu@memphis.edu

Natalie Person
Department of Psychology
Rhodes College
Memphis, TN 38112
person@rhodes.edu

Tanner Jackson
Department of Psychology
University of Memphis
Memphis, TN 38152-3230
gtjacksn@memphis.edu

Joe Toth
Institute for Defense Analyses
Alexandria, VA 22311
jtoth@ida.org

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Abstract: The Human Use Regulatory Affairs Advisor (HURAA) is a web-based facility that provides help and training on the ethical use of human subjects in research, based on documents and regulations in United States Federal agencies. HURAA has a number of standard features of conventional web facilities and computer-based training, such as hypertext, multimedia, help modules, glossaries, archives, links to other sites, and page-turning didactic instruction. HURAA also has more intelligent features: (1) an animated conversational agent that serves as a navigational guide for the web facility, (2) lessons with case-based and explanation-based reasoning, (3) document retrieval though natural language queries, and (4) a context-sensitive Frequently Asked Questions, called *Point & Query*. This paper describes the major modules and features of HURAA and evaluates the performance of document retrieval through natural language questions.

Introduction

The Human Use Regulatory Affairs Advisor (HURAA) is a web-based facility that provides help, training, and information retrieval on the ethical use of human subjects in research. The content of HURAA is derived from

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Federal agency documents and regulations, particularly the National Institutes of Health (NIH, 45 CFR 46), the Department of Defense (32 CFR 219, DoD Directive 3216.2), and particular branches of the US military. The users of the HURA Advisor are high-ranking military officials who must approve research protocols involving human subjects in studies sponsored by the Department of Defense (DoD). These users focus on fundamental ethical issues, but not the detailed procedures and paper work associated with gaining approval from Institutional Review Boards.

The design of HURAA was guided by a number of broader objectives. First, the layout and design of the web facility incorporate available guidelines in human factors, human-computer interaction, and cognitive science. Such guidelines are advocated by the Advanced Distributed Learning (ADL) Initiative of the DoD. Second, the architecture of the HURAA components needed to be conformant with the ADL standards for reusable instructional objects, as specified in the Sharable Content Objects Reference Model (SCORM 2001). The primary objective of having these standards is to allow course content to be shared among different lesson planners, computer platforms, and institutions. Third, HURAA was designed to optimize both learning and information transmission. High ranking military personnel have very little time, so it is imperative to promote the speed and quality of learning in web-based distance learning environments (Tobias & Fletcher 2000, SCORM 2001). This requires careful consideration of the pacing of the information delivery, the selection of content, and design of the tasks to be performed. Fourth, HURAA incorporated some of the sophisticated pedagogical techniques that have been implemented in intelligent tutoring systems (ITS) during the last two decades (Anderson, Corbett, Koedinger, & Pelletier 1995, Graesser, VanLehn, Rose, Jordan, & Harter 2001, VanLehn, Jones, & Chi 1992). Some of the lessons and modules had case-based, explanation-based, and question-based learning mechanisms in an effort to promote deeper mastery of the material. Fifth, the web site was supposed to be engaging to the user. HURAA incl,uded some persuasive multimedia that was intended to hook the user to continue on the website (Mayer 1997).

A sixth general objective was to optimize information retrieval when users actively attempted to search for information. Some users prefer to learn by actively exploring information, asking questions, and accessing answers to questions (Graesser & Person 1994, Graesser & Wisher 2001, Otero & Graesser, 2001), whereas many learners are more passive and rarely pose questions. A good web facility provides information quickly on demand for those occasions when users are curious, active, self-regulated learners. HURAA implements multiple methods of accessing information in a large space of documents. HURAA has hypertext and glossaries, which are conventional methods of information retrieval. But HURAA does not stop there. HURAA has a *Point & Query* facility (Graesser, Langston, & Baggett 1993), which provides answers to context-sensitive Frequently Asked Questions (FAQs). HURAA also accesses documents that provide answers to questions that the user formulates in English, using techniques in computational linguistics (Jurafsky & Martin 2000, Landauer, Foltz, & Laham 1998). It is the latter facility (i.e., document access via queries in natural language) that will receive primary attention in the present article. We will assess the performance of our natural language document retrieval facility in supplying informative and relevant information.

In summary, there are two goals of the present article. First, we present a snapshot of the modules of HURAA, with particular attention to those that provide information retrieval. Second, we report performance on our natural language document retrieval facility.

Modules and Features of the HURA Advisor

The home page of HURAA is presented below (Fig. 1). There are seven primary modules and seven secondary modules. Labels for these modules are presented in the left banner of the HURAA web page. The main display area in the middle of Figure 1 describes primary modules of HURAA. The interchange between the user and the HURAA is managed by an animated conversational agent (see upper left corner) and by discourse mechanisms that are designed to facilitate the dialogue (Graesser, Person, Harter, & TRG 2001, Graesser et al. 2001, Person, Graesser, Kreuz, Pomeroy, & TRG 2001). Many users will be high-level decision-makers with very little time to visit the site (i.e., 30 minutes or less) so HURAA needs to be engineered to maximize its coverage of critical information in the minimum amount of time. This requires some efficient dialog management techniques that are available in the fields of human-computer interaction and discourse processes. For example, the conversational agent briefly identifies the functions of major interface components the user clicks on, and offers recommendations on next steps

when each web page is first accessed. This prevents the first-time user from spending undue time analyzing the functions of interface features and figuring out what they are supposed to do next.

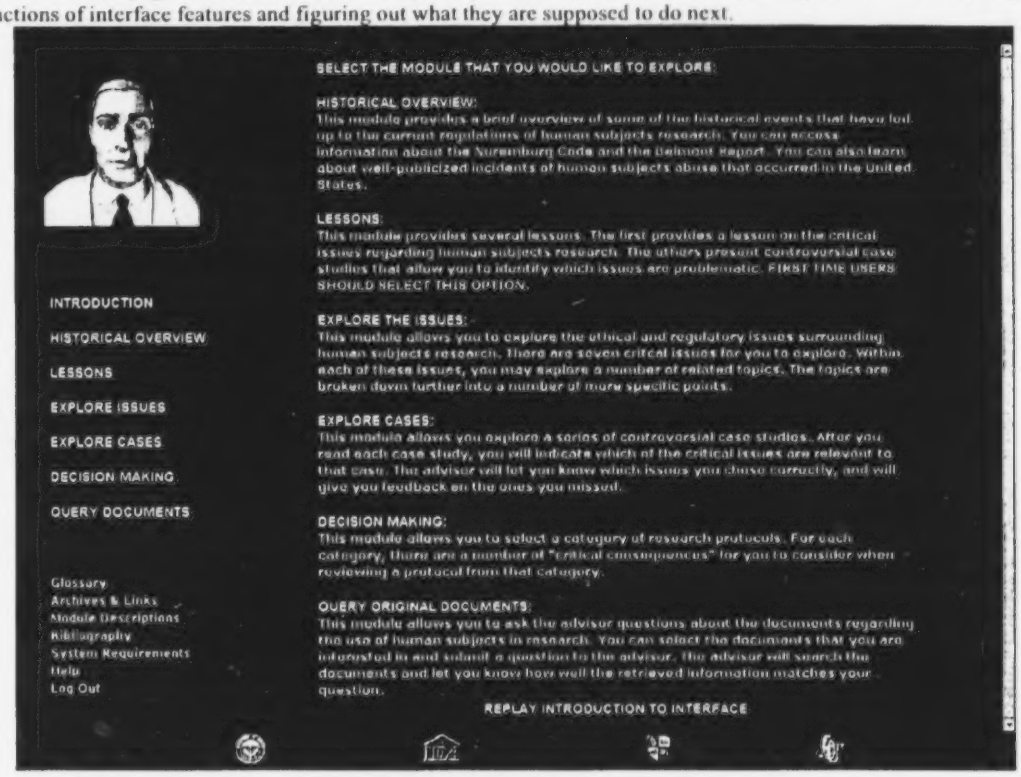
SELECT THE MODULE THAT YOU WOULD LIKE TO EXPLORE:
HISTORICAL OVERVIEW:
This module provides a brief overview of some of the historical events that have led up to the current regulations of human subjects research. You can access information about the Nuremburg Code and the Belmont Report. You can also learn about well-publicized incidents of human subjects abuse that occurred in the United States.
LESSONS:
This module provides several lessons. The first provides a lesson on the critical issues regarding human subjects research. The others present controversial case studies that allow you to identify which issues are problematic. FIRST TIME USERS SHOULD SELECT THIS OPTION.
EXPLORE THE ISSUES:
This module allows you to explore the ethical and regulatory issues surrounding human subjects research. There are seven critical issues for you to explore. Within each of these issues, you may explore a number of related topics. The topics are broken down further into a number of more specific points.
EXPLORE CASES:
This module allows you explore a series of controversial case studies. After you read each case study, you will indicate which of the critical issues are relevant to that case. The advisor will let you know which issues you chose correctly, and will give you feedback on the ones you missed.
DECISION MAKING:
This module allows you to select a category of research protocols. For each category, there are a number of "critical consequences" for you to consider when reviewing a protocol from that category.
QUERY ORIGINAL DOCUMENTS:
This module allows you to ask the advisor questions about the documents regarding the use of human subjects in research. You can select the documents that you are interested in and submit a question to the advisor. The advisor will search the documents and let you know how well the retrieved information matches your question.
REPLAY INTRODUCTION TO INTERFACE
INTRODUCTION
HISTORICAL OVERVIEW
LESSONS
EXPLORE ISSUES
EXPLORE CASES
DECISION MAKING
QUERY DOCUMENTS
Glossary
Archives & Links
Module Descriptions
Bibliography
System Requirements
Help
Log Out

Figure 1: Home Page of HURA Advisor

Major Modules

The seven modules of HURAA are enumerated below. Links for these seven modules are always present on the web page, in the banner on the left (Fig. 1).

(1) *Introduction*. The Introduction Module is a multimedia movie that plays immediately after a new user has logged in. It is designed to impress the user with the importance of protecting human subjects in research. It describes for the user "what" the site is, "who" should use the site, "why" the site is important, "how" the site works, and "when" the site should be used. It consists of a "voice-over" accompanied by images.

(2) *Historical Overview*. This module contains an additional multimedia movie highlighting some of the most famous abuses of human subjects in history. There are different options for the user to select, in a standard hypertext/hypermedia organization that allows the user to "drill down" to learn more about those topics. Users can also access information through Point & Query (Graesser et al. 1993) or a natural language query facility, as described later.

(3) *Lessons*. This module comprises four lessons that teach the user about the Seven Critical Issues relevant to ethical violations that were identified by Emmanuel et al. (2000). User learns how to apply them to particular cases that involve ethical abuses. After a case is presented, the user is then presented with the Seven Critical Issues and must decide, on a six-point scale, the extent to which there is a problem with each issue in that case. The user then receives feedback comparing his/her responses with those of a group of experts from the DoD, along with a brief explanation. Discrepancies are highlighted in red. This is a form of case-based reasoning, which is recognized to be

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appropriate for legal and ethical reasoning (Ashley 1990). Cases are dynamically selected on the basis of the user's previous responses, to ensure full coverage of the Seven Critical Issues.

(4) *Explore Issues*. This module expands the Seven Critical Issues into a number of topics and points, hierarchically organized in a hypertext system. The user drills down to learn more specific information about particular issues. Point & Query and natural language queries are also available.

(5) *Explore Cases*. This module has approximately 40 cases used in both the Lessons and Explore Issues modules. The user can drill down to see cases associated with a three-level hierarchy of issues, sub-issues, and sub-sub-issues.

(6) *Decision Making*. The Decision Making module is designed for those who need information about a specific category of protocol (e.g., drug studies, surveys). The user is presented with a list of protocol categories. Selecting one of the categories presents the user with a list of several "critical consequences," i.e., negative results that may occur from an incorrect decision. Selecting one of the critical consequences presents the user with a more complete description of a consequence associated with an incorrect decision.

(7) *Query Documents*. This module allows the user to ask a natural language question (or description) and then retrieves excerpts from various documents and HURAA content. The user can select any or all off several documents to search. For each document that the user selects, the top result selected by the computational linguistics software is displayed in a window. Beneath this window, the headings for the next four results appear. If the top choice is not the one that the user needs, s/he can click on the headings to read those excerpts. The search is driven by mechanisms described later in this article.

Secondary Modules

In addition to the seven major modules in HURAA, there are seven secondary modules that supplement the primary content and help the individual use the site.

(8) *Glossary*. The Glossary contains over 200 terms relevant to human subjects research. The user may either browse the alphabetized listing or search by entering a term. Additionally, throughout HURAA, glossary terms are highlighted and the user may click on the term to see the definition or a list of related terms.

(9) *Archives & Links*. This module contains links to military regulations and relevant civilian documents. There are links to external web sites of military and nonmilitary organizations, and of online tutorials. Original documents are needed when the user has to access the exact text that stipulates policies and procedures.

(10) *Module Descriptions*. This module contains text descriptions for each of the primary modules. It is a good single-page overview of what HURAA has to offer in training.

(11) *Bibliography*. This lists relevant resources, including references for the content of HURAA and other publications that are relevant to the protection of human subjects in research.

(12) *System Requirements*. This module contains links to download necessary software components for running HURAA. This page appears automatically at the beginning of a new user's session. It remains available in case a user is having problems with particular HURAA components.

(13) *Help*. This has helpful hints for users who are having problems navigating HURAA.

(14) *Log Out*. The user logs off the web site when the user clicks on this.

Navigation and Information Retrieval Features

HURAA has a number of features that support diverse methods of navigation and information retrieval. In addition to the traditional features of web sites (such as Graphical User Interfaces and Hypertext drill down), there are a number of unique intelligent features that are now just starting to be used on web sites: an Animated Conversational Agent, Point & Query, and Natural Language Query.

It is convenient to view the various forms of navigation and information retrieval from the perspective of the five approaches to navigation discussed by Quesenbery (2001). The different forms of navigation and retrieval that exist in each of the modules and features of HURAA are identified below (Tab. 1).

1. *Browsing* – "*I want to see what's available.*"
2. *Finding* – "*I want to locate something specific.*"

3. *Query – "I want to see items that meet my criteria."* Query navigation is supported in the Query Documents module and other modules by allowing the user to ask a natural language question. Query navigation is also supported by the P&Q option, although the queries are limited to those provided by HURAA. The advantage of P&Q is that the user can ask sophisticated questions and receive answers specifically tailored to those sophisticated questions, rather than risking a bad search result.
4. *Structured - "I want to be led through a series of choices to help me narrow my focus."* .
5. *Guided – "I want to be led through the information."*

MODULE/FEATURE	Browsing	Finding	Query	Structured	Guided
Introduction					X
Historical Overview	X	X	X	X	
Lessons			X	X	
Explore Issues	X	X	X	X	
Explore Cases	X	X		X	
Decision Making				X	
Query Documents			X		
Glossary	X	X	X		
Archives & Links	X	X			
Module Description	X				
Bibliography	X				
System Requirements	X				
Help	X				
Point & Query	X	X	X	X	

Table 1: Forms of Navigation and Retrieval for Different HURAA Modules & Features

Animated Conversational Agent

This is a talking head with synthesized speech, facial expressions, and pointing gestures. The Agent tells the user what to do next when the user first encounters a web page. For example, when the user enters the Explore Issues Module, the Agent says, "Select the issue that you would like to explore." The talking head moves to direct the user's attention to some point on the display. For example, the talking head looks down when he says, "You may select one of the options below me." The talking head also tells the user what each primary and secondary module is supposed to do, after the user rests the mouse pointer over the module link for more than 2 seconds. The Agent is designed to project an authoritative persona and to help the user navigate through the interface more quickly. Many novice users are lost and don't know what to do next when they encounter a page. The Agent is designed to reduce this wasted time.

Point & Query

The interface displays a question mark (?) for some hot spots. When the user clicks on the question mark, a menu of questions appears. The user selects a question by clicking on it, and then the answer appears. Thus, the user can quickly ask a question with two clicks of a mouse. Users are also exposed to good, relevant questions because the designer of the P&Q handcrafts these Question-Answer items. P&Q can be viewed as a context-sensitive Frequently Asked Question (FAQ) facility.

Natural Language Query

The user can ask a question by typing it in English. The English description can be an interrogative or declarative expression of any arbitrary length. The user can declare what document or set of documents to search for an answer. HURAA accesses 5 paragraphs from the source documents that should contain relevant information to the query. The highest matching document identified by the computational linguistics software is automatically presented; selections 2-5 have a brief description presented, with an option for the user to view any of these paragraphs in their entirety.

Evaluation of Performance of Natural Language Queries

The natural language query feature is the most direct form of information retrieval because the user does not need to depend on or wait for the web content and interface to set the stage for posing a particular question. The user simply asks the question in English, at any point in the session with HURAA. In contrast, all of the other information retrieval facilities require the user to sift through the web pages, menu options, or hypertext hot spots until the right point when a particular question can be posed, if indeed it can be posed at all. Because of this special status of the natural language query feature, we conducted a performance analysis on how well different search engines fetched relevant and informative information. A natural language query facility is useful to active learners only to the extent that it provides relevant, informative information.

We tested 8 search engines, consisting of all combinations of the presence or absence of the following three match functions: (1) Latent Semantic Analysis (called *LSA*), (2) frequency-weighted keyword matching (called *Keyword*), and (3) glossary word matches (called *Glossary*). Each match function produces a value of 0 to 1 when considering the overlap between the words in query Q and the words in paragraph P. The paragraph that has the highest overlap, i.e., max {overlap(P,Q)}, is returned when one of the three functions is considered. When multiple match functions are considered (such as LSA+Glossary), then the paragraph is selected that has the highest average match values from the multiple functions.

Latent Semantic Analysis (LSA)

Latent Semantic Analysis (LSA) has recently been proposed as a statistical representation of a large body of world knowledge (Landauer, Foltz, & Latham 1998). The LSA uses a statistical method called "singular value decomposition" (SVD) to reduce a large Word by Document co-occurrence matrix to approximately 100-500 functional dimensions. The Word-by-Document co-occurrence matrix is simply a record of the number of times word W_i occurs in document D_j. A document may be defined as a sentence, paragraph, or section of an article. Each word, sentence, or text ends up being a weighted vector on the K dimensions. The "match" (i.e., similarity in meaning, conceptual relatedness) between two unordered bags of words (single words, sentences, or texts) is computed as a geometric cosine (or dot product) between the two vectors, with values ranging from 0 to 1. From the present standpoint, LSA is used to compute the highest matching paragraph from the document space that is relevant to the question Q.

Word frequency weighted keyword matching (Keyword)

HURAA has a lexicon with word frequency norms that are available electronically (Francis & Kucera 1982). The frequency of usage is the number of times the word occurs in a representative sample of printed text in the English language. Rare words should have higher weight than frequent words because they are more distinctive. Therefore, each word W_i is weighted according the reciprocal of is word frequency value $fr(W_i)$: $[1/ fr(W_i)]$. An overlap score is computed that reflects the proportion of words that overlap between question Q and paragraph P (weighted by the reciprocal of the word frequency).

Glossary word matches (Glossary)

Glossary words are defined as all words in the HURAA glossary. These are technical words and terms relevant to the ethical use of human subjects. An overlap score is computed that reflects the proportion of glossary words that overlap between question Q and paragraph P.

Three experts on research ethics were instructed to generate 20 questions about four sections of the subject matter of HURAA (80 questions total). For each question, there were 8 paragraphs as answers, corresponding to the 8 search engines. The experts judged whether or not each paragraph was relevant to the question (Relevance Judgment) and an informative answer to the question (Informativity Judgment). The performance of the search engine was scored as the proportion of paragraph answers that were judged as relevant or informative. The mean proportion scores are presented below (Tab. 2).

The different search engines clearly yielded different affects on relevance and informativity proportion scores. A one-way ANOVA was found to show statistically significant differences in relevance proportion scores as a function of search engines, $F(7, 88) = 21.03$, $p < .01$, $MSe = .02$, as well as differences in informativity proportion scores, $F(7, 88) = 17.29$, $p < .01$, $MSe = .02$. The keyword match function was the clear winner, and significantly higher than each of the other seven search engines. Interestingly, about 2/3 of the fetched paragraphs were perceived as relevant and informative when the keyword search engine was used. This performance is quite impressive. It supports the claim that the performance of the natural language query module is sufficiently impressive that it should be a worthwhile information retrieval facility for active learners who like to ask questions.

SEARCH ENGINE	Relevance	Informativity
LSA	.40	.48
Keyword	.64	.66
Glossary	.19	.22
LSA+Keyword	.55	.56
LSA+Glossary	.26	.30
Keyword+Glossary	.36	.38
LSA+Keyword+Glossary	.37	.39
Random	.06	.08

Table 2: Relevance and Informativity Proportions for Eight Search Engines for Natural Language Queries

Acknowledgements

This research was directly supported by contracts from the Office of Naval Research (N61339-01-C1006) and the Institute for Defense Analyses (AK-2-1801), and was partially supported from grants by the National Science Foundation (REC 0106965) and the DoD Multidisciplinary University Research Initiative (MURI) administered by ONR under grant N00014-00-1-0600. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of ONR, IDA or NSF.

References

Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The Journal of the Learning Sciences*, 4, 167-207.

Ashley, K.D. (1990). *Modeling legal argument: Reasoning with cases and hypotheticals*. Cambridge, MA: MIT Press.

32 CFR 219 (1991). *Protection of Human Subjects*, Department of Defense.

Emmanuel, E. J., Wendler, D., & Grady, C. (2000). What makes clinical research ethical? *Journal of the American Medical Association*, 283, 2701-2711.

DoD Directive 3216.2 (1993). *Protection of Human Subjects in DoD supported research*, Department of Defense.

Francis, W.N., & Kucera, N. (1982). *Frequency analysis of English usage*. Boston, MA: Houghton-Mifflin.

Graesser, A. C., Langston, M. C., & Baggett, W. B. (1993). Exploring information about concepts by asking questions. In G. V. Nakamura, R. M. Taraban, & D. Medin (Eds.), *The psychology of learning and motivation: Vol. 29. Categorization by humans and machines* (pp. 411-436). Orlando, FL: Academic Press.

Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal*, 31, 104-137.

Graesser, A.C., Person, N., Harter, D., & TRG (2001). Teaching tactics and dialog in AutoTutor. *International Journal of Artificial Intelligence in Education*.

Graesser, A.C., VanLehn, K., Rose, C., Jordan, P., & Harter, D. (2001). Intelligent tutoring systems with conversational dialogue. *AI Magazine*, 22, 39-51.

Graesser, A.C., & Wisher, R.A. (2001). Question generation as a learning multiplier in distributed learning environments. *United States Army Research Institute for the Behavioral and Social Sciences, Technical Report 1121*.

Jurafsky, D., & Martin, J.H. (2000). *Speech and language processing: An introduction to natural language processing, computational linguistics, and speech recognition*. Upper Saddle River, NJ: Prentice-Hall.

Landauer, T.K., Foltz, P.W., Laham, D. (1998). An introduction to latent semantic analysis. *Discourse Processes*, 25, 259-284.

Mayer, R.E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, 32, 1-19.

NIH 45 CFR 46 (1991). *Protection of Human Subjects*. National Institutes of Health Code of Federal Regulations.

Otero, J., & Graesser, A.C. (2001). PREG: Elements of a model of question asking. *Cognition & Instruction*, 19, 143-175.

Person, N.K., Graesser, A.C., Kreuz, R.J., Pomeroy, V., & TRG (2001). Simulating human tutor dialog moves in AutoTutor. *International Journal of Artificial Intelligence in Education*.

Quesenbery, W. (2001). On beyond help: Meeting user needs for useful online information. *Technical Communication*, 48, 182-188.

Sharable Content Object Reference Model (SCORM), Version 1.1. www.adlnet.org

Tobias, S., & Fletcher, D. (200)(Eds.) *Training and retraining: A handbook for business, industry, government and the military*. New York: Macmillan.

VanLehn, K., Jones, R.M., & Chi, M.T. (1992). A model of the self-explanation effect. *The Journal of the Learning Sciences*, 2, 1-59.

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